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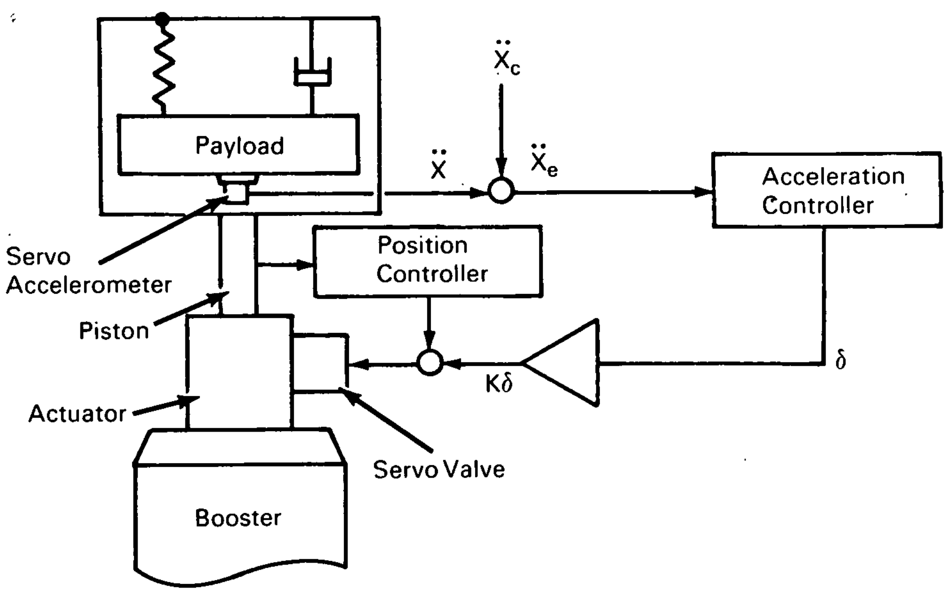
Improved Active Vibration Isolator



The active vibration isolator, shown in schematic form, is designed to perform the following functions simultaneously: (1) isolate a flexible structure or payload from disturbances such as launch vehicle vibrations; (2) attenuate the response of a flexible structure to transient disturbances such as staging loads; and (3) maintain the equilibrium position of the payload within predetermined limits over a wide range of steady loads and accelerations. The isolator is an automatic controller that is especially suited for vibration protection of systems which experience changes in steady load and/or accelerations, such as on spacecraft. It may also be effectively used to provide vibration protection for systems during ground transportation, shipboard operation, and aircraft flight.

A passive vibration isolator, that is, a system which employs springs and dampers to isolate and attenuate dynamic disturbances, does not maintain a fixed equilibrium position and is not effective in isolating a payload from disturbances having frequencies that are less than $\sqrt{2}$ times the natural frequency of the isolator. Active isolator systems that have been studied previously are not effective in reducing the resonant response of a flexible body attached to a rigid mounting platform.

The new active vibration isolator consists of the following components: sensing elements to measure the dynamic response of the flexible payload and position of an actuator; electrical control networks to compare the signals of the sensing elements with preset standards and to provide an output to the

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actuator; and the actuator itself which applies a force to the payload so as to null the response of the payload as well as to maintain a fixed equilibrium position.

The acceleration $\ddot{x}$ of the flexible payload is measured by a servo accelerometer and the signal is compared with a desired or command acceleration signal $\ddot{x}_c$ (which for this application is set equal to 0). The error signal $\ddot{x}_e$ is then sent to the acceleration control network for compensation. The output δ of the acceleration control network is amplified, and the resulting signal $K\delta$ is used to drive the servo valve. The actuator responds to the servo valve command and moves the piston to null the response of the payload. A linear potentiometer attached to the actuator piston measures the position of the piston. The difference between the measured position (Y) and the command position (Y_c) is the error signal (Y_e) which is fed to a secondary control loop. This loop restricts the isolator to move about a predetermined, fixed position.

Notes:

1. Payloads to be isolated can be discrete or distributed systems.
2. Sensing elements can be chosen to respond to position, velocity, or acceleration or to combinations of these variables.
3. The actuator can be hydraulic, pneumatic, or electromechanical.
4. Inquiries concerning technical details may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Langley Station
   Hampton, Virginia 23365
   Reference: B68-10123

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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